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Title of the Invention
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SECURING PLUGS IN OVER-SIZED HOLES

Background of the Convention

This invention relates to a method of securing plugs (particularly but not exclusively screw-receiving plugs) in oversized holes formed in fixtures, - thereby to enable, for example, screws, bolts or even nails to be secured in a fixture. The invention also provides means for use in carrying out that method.

10 In the description and claims that follow hereafter, the term "screws" will include "bolts" as well, and will encompass screws that have screw-threaded cylindrical shanks as well as screws having screw-threaded conical shanks.

15 Devices and appliances are frequently secured to a supporting fixture or structure (e.g. a wall, cabinet or panel) by means of screws. In some cases, such screws cannot be screwed directly into the structure because of
20 the nature of the material of the structure, but instead are inserted into a plug of a screw-receiving material that has been previously inserted in a frictionally-engaging manner in a hole preformed in the structure. Driving the screw into the plug tends to radially enlarge the plug,
25 thus causing the frictional engagement of the plug with the structure to intensify and thereby resist both longitudinal and rotational displacement of the plug within the hole as the screw is driven home to firmly secure the device or appliance to the structure.

30 Difficulties can arise in preforming the hole in the structure, for example - where the material of the structure is not homogeneous, or is easily eroded non-uniformly during the drilling of the hole. As a result, 35 the hole is sometimes larger than desired (and/or misshapen) for the size of the plug intended to be engaged therein. This happens for example where the hole is being drilled in mortar bonds between bricks.

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In such cases remedial measures may include using a larger plug to receive the plug or screw originally intended to be used, or simply a larger screw; or alternatively filling the over-sized hole with a suitable homogeneous plastic filler material, and then redrilling the necessary plug-receiving hole in the filler material after it has hardened.

Unfortunately, the latter procedure unduly prolongs the time of securing the screw since the hardening of the filler material requires a relatively long setting time before it can safely carry a load, because of the bulk of the filler material to be hardened, and its almost complete enclosure in the hole. Suitable plastic fillers include epoxy resins, but they are relatively expensive, require special mixing procedures, have long hardening times, and can present problems in safe handling and storage, e.g. dermatological problems for the user.

Summary of the Invention

The present invention seeks to provide a method and means for enabling plugs (e.g. screw-receiving plugs) to be secured in circumstances where the preformed hole is unfortunately enlarged beyond the intended size, which method and means do not require resort to the use of a larger plug or screw, or a long filler-hardening time.

According to the present invention, a method of securing a plug, for example a screw-receiving plug, in an over-sized preformed hole comprises the steps of: (a) providing at least one piece of a loosely-woven fabric carrying consolidated thereon a quick-setting filler material, which fabric piece is sized to envelop at least circumferentially the plug intended to be used; (b) enveloping the plug at least circumferentially in the fabric piece; (c) causing activation of the filler material thereby to initiate hardening and eventual setting of the filler material; and (d) inserting the enveloped plug without delay in the oversized hole in a manner such as to ensure filling of the

oversized hole with the enveloped plug. After the elapse of a relatively short filler-hardening time, the intended screw (or nail) may be inserted in and screwed into the plug.

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By the term "loosely-woven fabric" is meant any fabric whether woven or knitted which is capable of constituting an open matrix material or substrate on to which the filler material may be consolidated or impregnated. This term shall be construed broadly in this manner wherever appropriate in this description and in the appended claims. Such a fabric may comprise for example a gauze material or a leno weave material.

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Where the filler material requires activation by air, as in the case of some synthetic resin filler materials e.g. a polyurethane resin, activation will commence at the moment of releasing the fabric from an airtight storage container, so that enveloping the plug in the fabric occurs shortly after air activation has started.

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Where the filler material requires activation by water, as in the case of one preferred filler material, for example plaster of Paris, activation is achieved by wetting the enveloped plug with water.

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Enveloping the plug in the filler impregnated-fabric provides a reliable method of ensuring that sufficient filler material is carried with the plug into the hole to its fullest extent. This is extremely difficult to achieve without the fabric carried on the plug, so that safe securing of the plug in the oversized hole is then unpredictable and unreliable.

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Water-activated filler materials have the advantage compared with the air-activated filler materials that they are relatively cheap and plentiful, and give rise to few dermatological problems for the user.

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The preferred water-activated filler material comprises plaster of Paris, though any other suitable filler material manufactured from gypsum will suffice.

- 5 If desired, the filler material may have mixed with it short, strength-enhancing fibres of glass, carbon or other suitable material.

- 10 The fabric piece may be in the form of a tape or strip, and be wound on to the plug thereby to envelop it circumferentially. Alternatively, the fabric piece may be circular in shape, or substantially so, and be placed over the closed end of the plug and then smoothed longitudinally along the plug to the open end thereof so as to envelop it
- 15 circumferentially in a substantially uniform manner.

- According to a further aspect of the invention, there is provided for use in the method of the present invention a piece of a loosely-woven fabric carrying consolidated
- 20 thereon a quick-setting filler material, which fabric piece is in the form of a tape which is transversely weakened at positions spaced along the tape so as to enable ready detachment of successive pieces as desired for use in practising a method according to the present invention.

- 25 Said filler material may, if desired, have mixed with it short, strength-enhancing fibres of glass, carbon or other suitable material.

- 30 The tape may be wound in the form of a roll, or alternatively it may be folded upon itself at said weakened positions in a fan-fold manner.

- Where air-activated filler material is used, it is
- 35 essential to enclose the fabric tape in an air-tight enclosure to prevent activation until the tape is about to be put into use.

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Where water-activated filler material is used, it is necessary to enclose the fabric tape in a watertight enclosure so as to ensure its storage in a dry condition prior to use.

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The present invention also provides for use in the method of the present invention an enclosure containing a selection of separate filler-carrying fabric pieces of substantially circular or rectangular configuration, which pieces may be all of one size, or of various sizes to suit different plug sizes.

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Preferably, the airtight and watertight enclosures incorporate appropriate resealing means for maintaining respectively the airtightness and watertightness of the respective enclosures, and contain or carry printed instructions setting out the manner of using the fabric pieces in accordance with the present invention.

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According to another aspect of the present invention, there are provided for use in carrying out the present invention ready-made (pre-prepared) units each comprising a said plug having secured therearound a sleeve (preferably closed at one end) of a said loosely-woven fabric carrying consolidated thereon a said quick-setting filler material, with or without said strength-enhancing fibres. Such fabric may be retained on the plug by being impaled on radial, retaining projections such as are commonly formed on screw-receiving plugs, or by an adhesive substance.

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Other features of the present invention will appear from a reading of the description that follows hereafter and of the claims appended at the end of that description.

5 Various methods incorporating the present invention, of securing screws in a fixture, and means for use in practising those methods, will now be described by way of example, and with reference to the accompanying drawings, in which:

10 *Brief Description of the Drawings*

Figure 1 shows a vertical sectional view of part of an appliance secured to a vertical brick wall by conventional wood screws, the section being taken in the plane including the longitudinal axes of two screws;

15 Figures 2 and 3 show respectively rectangular and circular pieces of a woven fabric carrying an embedded filler material;

20 Figure 4 shows in a pictorial manner a plastic screw-receiving plug around which is being wound the rectangular fabric piece of Figure 2;

25 Figure 5 shows in a pictorial manner a plastic screw-receiving plug along which is being pressed and smoothed the circular fabric piece of Figure 3;

30 Figure 6 shows in a pictorial manner a plastic screw-receiving plug about to be forced longitudinally along with a circular fabric piece of Figure 3 into a hole preformed in the brick wall;

35 Figure 7 shows in a pictorial manner a resealable waterproof enclosure containing several rectangular filler-carrying fabric pieces of the kind shown in Figure 2;

Figure 8 shows in a pictorial manner a filler-carrying woven fabric tape for use in providing as required

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detachable rectangular fabric pieces of the kind shown in Figure 2, the tape being wound in the form of a roll;

Figure 9 shows in a pictorial manner a filler-carrying woven fabric tape for use in providing as required detachable rectangular fabric pieces of the kind shown in Figure 2, the tape being folded in a fan-fold manner; and

Figure 10 shows in a pictorial manner a ready-made unit comprising a conventional plastic, screw-receiving plug such as is shown in Figures 4 and 5, having secured thereon a sleeve of a said loosely-woven fabric carrying an embedded filler material similar to the fabrics shown in the Figures 2 and 3.

15 *Description of the Preferred Embodiments*

Referring now to the drawings, an appliance 10 is to be secured to a brick wall structure 12 in the manner shown in Figure 1, by means of so-called 'wood screws' (i.e screws having screw-threaded conical shanks) 14, using plastic plugs 16 of conventional kind disposed in suitably positioned holes 18,20 preformed in the brick wall 12.

The intended positions of some of those holes (18) require drilling in the material of the bricks 22 themselves, so that no difficulty is normally encountered in drilling them to a diameter that is correct for the intended plastic plugs.

However, the intended positions of other holes (20) coincide with respective mortar bonds 24 disposed between adjacent bricks 22. Due to the weakness of the mortar often used in such bonds 24, or the presence of small chippings or pebbles in the mortar, drilling of those holes 20 with the requisite masonry drill can result in holes that are somewhat oversized and/or badly mis-shapen, as indicated in Figure 1. As a consequence, the intended plastic plugs 16 are too small in diameter to frictionally engage with the encircling mortar, and so cannot receive

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and secure the screws intended to be engaged in the plugs. Hence, when a fixing screw 14 is presented to the plug 16 and rotated, the screw and the plug rotate together.

5 In a first embodiment of the present invention, this difficulty is overcome, in accordance with the principles of the present invention, by providing for each such oversized or mis-shapen hole 20 at least one piece 26 of a loosely-woven fabric (for example - cotton) carrying
10 consolidated thereon a dry, water-activated, quick-setting filler material 28 (for example - plaster of Paris). Each such fabric piece 26 is sized to be capable of enveloping circumferentially at least a major part of the intended plastic plug 16 when engaged therearound.

15 The method of the present invention now involves for each plug 16 to be secured in a defective (i.e. over-sized or mis-shapen) hole 20, engaging one such fabric piece 26 securely around the plastic plug 16 so as to closely
20 envelop it circumferentially along its length.

The fabric piece 26 and filler material 28 are then wetted with water so as to activate the filler material 28, and thereby initiate its setting (hardening) process.

25 The wetted, enveloped plug (16,26,28) is then inserted without delay into the defective hole 20 so as to substantially fill it, the fabric piece 26 and filler material 28 then occupying the spaces between the plug 16
30 and the bore of the hole 20.

After the elapse of the requisite (relatively short) filler-hardening time, the intended screw 14 is inserted in and screwed into the plug 16. The whole process may
35 require only as little as five minutes.

Final tightening of the screw with the appliance in position is normally and preferably delayed for a few

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The fabric piece 26 may be in the form of a short tape or strip as indicated in Figure 2, and be wound around the plug in the manner shown in Figure 4 thereby in effect to
5 enlarge its diameter.

15 An alternative procedure may be used instead if desired. Instead of applying the fabric piece 30 (or even 26) to the plug 16, then wetting it and forcing the plug enveloped in the fabric piece into the hole 20, the fabric piece 30 is
20 first wetted to start the hardening process, and then placed centrally over the defective hole 20, as shown in Figure 6, whereafter the plug 16 is pressed against the centre of the fabric piece thereby to carry the fabric piece with the plug as it is forced longitudinally into the
25 defective hole, the fabric piece and filler material again filling the spaces between the plug 16 and the hole 20. Any unwanted parts of the fabric which protrude from the hole may be trimmed away with scissors or a craft knife.

35 Where the oversizing of the drilled hole 20 is substantial,
it may require the use of two (or possibly more) fabric
pieces 26 or 30 lying on top of one another to provide the
requisite amount of fabric and filler material to fill the

spaces between the hole 20 and the plug 16. In this case, the process may require a slightly longer time (possibly as much as ten minutes) to achieve satisfactory securing of the plug, depending on how oversized the hole 20 is and thus how many pieces of filler-carrying fabric 26 or 30 needed to be used.

For use in practising the method of the present invention, there may be provided in a suitable water-proof package 32 a plurality of fabric pieces 26 or 30 of similar sizes, or as desired - assorted sizes. The fabric pieces may be separate one from another, ready for withdrawal one by one from the package.

Alternatively, the package 32 may enclose filler-carrying fabric in the form of a tape (or strip) 34, which tape has been weakened transversely (e.g. by perforations) at positions 36 spaced along the length of the tape so as to enable separate pieces 38 of the tape to be readily detached. For convenience the tape may be wound in the form of a roll 40 as shown in Figure 8. Alternatively, the tape may be folded repeatedly upon itself at the weakened positions 36 and packaged in fan-fold manner, as shown at 42 in Figure 9.

The packages preferably include closure means (not shown) for resealing them in a water-proof manner after withdrawing a fabric piece.

Preferably, the packages carry within them or externally thereon a set of instructions for using the enclosed fabric pieces in accordance with the principles of the present invention.

It will be appreciated that the method of the present invention may be used in any situation where a plastic (or other) plug has to be disposed in any larger-than-desired hole.

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Whilst the above description is directed to the securing of a wood screw in a plastic plug, the procedure described there is equally applicable to the securing of such a screw in any form of plug, whether it be of a plastics material, wood, or a metal. Furthermore, the procedure may be used in the same manner for securing plug devices intended for use with plasterboard panels, or for plugs intended to receive nails (instead of screws).

Moreover, the procedure described above may equally be used in respect of a bolt having a screw-threaded cylindrical shank and intended to form part of a masonry bolt device, or part of a plug device intended for use with plasterboard panels.

By quick-setting filler material is meant material that has typically a setting time of up to about ten minutes.

Fabric for use in practising the present invention may comprise fibres of cotton, or any suitable synthetic plastics material (e.g. polypropylene), or even carbon or glass, and may be woven or knitted in any suitable manner, regularly or randomly. Fabric of the kind known as "leno" weave fabric is particularly suitable. Gauze fabrics are also useful in the present context.

The quick-setting filler material may be any suitable material derived from gypsum, and which can be consolidated on and/or within the intertices of the woven fabric. Other water-activated filler materials may be used instead. If desired, short (preferably less than 5mm in length), strength-enhancing fibres of glass, carbon or other suitable material may be mixed in with the filler material.

For convenience of the user, there may be provided, and marketed as such, ready-made (pre-prepared) units (Figure 10) each comprising a screw-receiving plug 16, carrying thereon a sleeve 46, preferably closed at one end,

of a loosely-woven fabric having consolidated thereon a said dry, water-activated, quick-setting filler material. The plug is similar to that shown (16) in the Figures 3 and 4, whilst the fabric and filler are similar to those (26-30) used in the Figures 2 and 3. The sleeve 46 is retained on the plug 16 by radial retaining projections 48 formed on the plug (also seen in Figures 4 and 5); if desired the sleeve may be secured instead by an adhesive.

10 One form of water-activated filler-carrying fabric (as referred to above) is currently used in the medical field, for the making of splints and casts. For example, plaster of Paris bandage commercially available under the trade mark "GYPSONA" from the company 'Smith and Nephew' has been
15 successfully used in experiments with methods according to the present invention. It is described as comprising a 'leno weave gauze cotton' which carries gypsum.

20 Methods according to the above-described embodiment of the present invention have the advantages that they are simple, involve only simple non-damaging chemical materials, and are relatively swift to practise.

25 In a second embodiment of the present invention, the method of securing the plug 16 in the hole 20 is generally similar to that described in the above-described first embodiment, with the exception that the filler material 28 comprises instead an air-activated synthetic resin material, e.g. polyurethane resin. In this case activation of the filler
30 material starts with the withdrawal of the filler-impregnated woven fabric 26,28 from its air-tight storage enclosure. Hence, there should be no appreciable delay in inserting the plug 16 with its enclosing filler-impregnated fabric 26,28 into the hole 20.

35 There is likewise currently available for use in the medical field, for the making of splints and casts, a loosely-woven fabric 26 carrying an air-activated filler

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material 28. That material is currently available under the trade name "DYNACAST EXTRA" from the company 'Smith & Nephew'. It is described as comprising a 'fibreglass knitted substrate' carrying a filler material comprising 'low tack polyurethane resin'. This second material has been successfully used in experiments concerning the present invention.

This second embodiment has the disadvantage compared with the first embodiment that the woven fabric carrying the resin filler material is relatively expensive, may adversely affect the user's skin, and needs greater care in handling it because of its sensitivity to air, which could result in premature hardening of the filler material before being brought into use.

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